Oceanographic Monitoring in the Monterey Bay National Marine Sanctuary to Help Understand Ecological Patterns and Inform Marine Protected Area Evaluation

Andrew P. Reynaga, Alex Macleod, Olivia Cheriton, Mark Carr

Partnership for Interdisciplinary Studies of Coastal Oceans

University of California, at Santa Cruz

Introduction

The Office of National Marine Sanctuaries (ONMS) and PISCO have established collaborative research and monitoring programs throughout the Monterey Bay National Marine Sanctuary (MBNMS), including long-term monitoring of the biological communities associated with both rocky intertidal and shallow subtidal environments (e.g., kelp forests). Closely located near many of these ecological monitoring stations are oceanographic moorings. This extensive network of moorings, called the ONMS-PISCO oceanographic mooring array, was developed to monitor temporal and spatial patterns of near-shore circulation and water temperature in the MBNMS. Following the establishment of the Marine Protected Areas (MPAs) along the Central Coast Study Region, PISCO conducted baseline ecological monitoring at sites within safe diving limits (Carr, Malone, 2010). Because physical processes can strongly influence important biological processes such as nutrient supply, growth rates, larvae transport, and primary productivity, the development of MPA monitoring programs that take into account oceanographic variability is a critical step in our ability to accurately assess whether a given MPA is meeting its design objectives . Recently, seven benthic moorings were added to supplement the ONMS-PISCO oceanographic mooring array, ensuring hydrographic data collection both inside and outside of all MPAs monitored by PISCO. Here we describe the new design and operation of the ONMS-PISCO oceanographic mooring array in the context of MPA development, monitoring, and evaluation.

Results

With a few exceptions, comparison sites show near identical temperature profiles throughout the year.

Figure 2 is an example of comparison sites showing consistent temperature data. The data were collected on the ONMS-PISCO mooring at Weston, which lies within the Pt Lobos MPA, and on a benthic MPA mooring at Malpaso, a reference site south of the reserve.

Figure 3 illustrates the temperature profiles at the Pt Sur MPA ONMS-PISCO mooring, and at the benthic mooring located within the Southwreck reference site. The two follow a similar trend. However, a slightly colder profile may be observed at Pt Sur which is within a very active upwelling center.

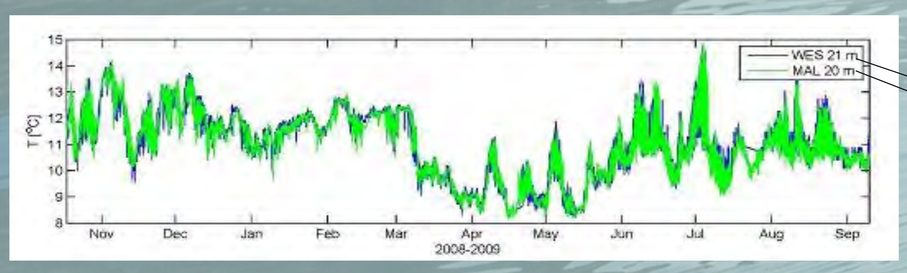


Figure 2. Malpaso (MAL) Benthic Mooring Plotted Against Weston (WES) Long Term Mooring

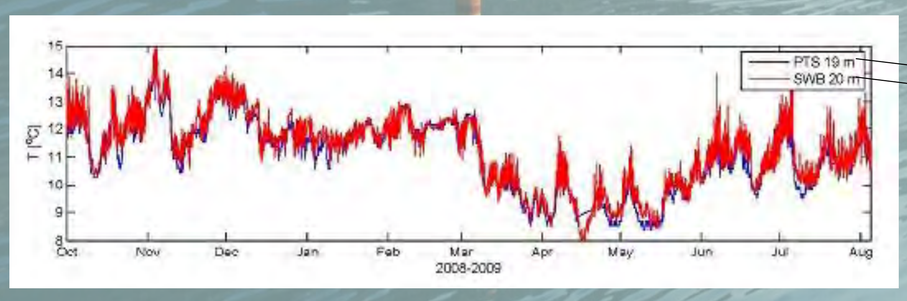


Figure 3. Southwreck (SWB) Benthic Mooring Plotted Against Pt Sur (PTS) Long Term Mooring

Conclusion

•While the oceanographic data collected by the MPA monitoring program may not vividly characterize the complexities of our nearshore circulation patterns along the central coast, they do provide better grounds for evaluation of MPA effectiveness as they capture physical variation between MPAs and reference sites (Carr, Woodson, In Press).

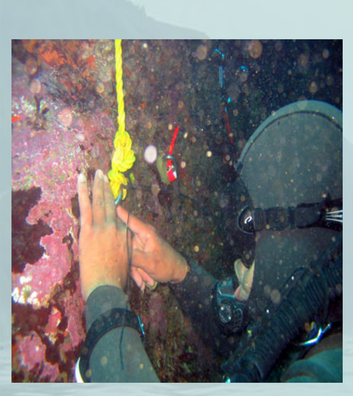
•Oceanographic conditions vary across geographical ranges. When evaluating large networks of MPAs, this variation necessitates a monitoring system which can account for these differences and couples study sites to reference sites accordingly (Hamilton et al, 2009).

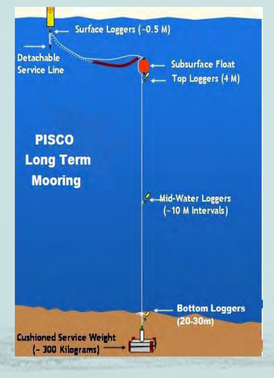
Materials and Methods

To supplement the existing ONMS-PISCO moorings, a 2007 series of benthic MPA moorings was constructed of small buoys attached 2 meters above the bottom to a 25-pound weights. The loggers were attached 1 meter off the seafloor to maintain consistency with the existing ONMS-PISCO oceanography moorings. Two replicates were deployed at each site denoted in Figure 1 as “Benthic MPA moorings.” Temperature was recorded in 15 minute intervals for the year.

Upon mooring retrieval during PISCO’s 2008 field season, several benthic moorings had migrated away from the deployment site due to drag inflicted by the recruitment of *Macrocystis pyrifera* onto the small buoys.

To prevent movement during subsequent years, the temperature loggers were attached directly to solid substrate via stainless eyebolts. Each of two eyebolts anchors a replicate logger, minimizing surface to which *Macrocystis* can recruit. A third, independent eyebolt holds a small float used as an aid to recovery. Loggers continue to record data at 15 minute intervals.





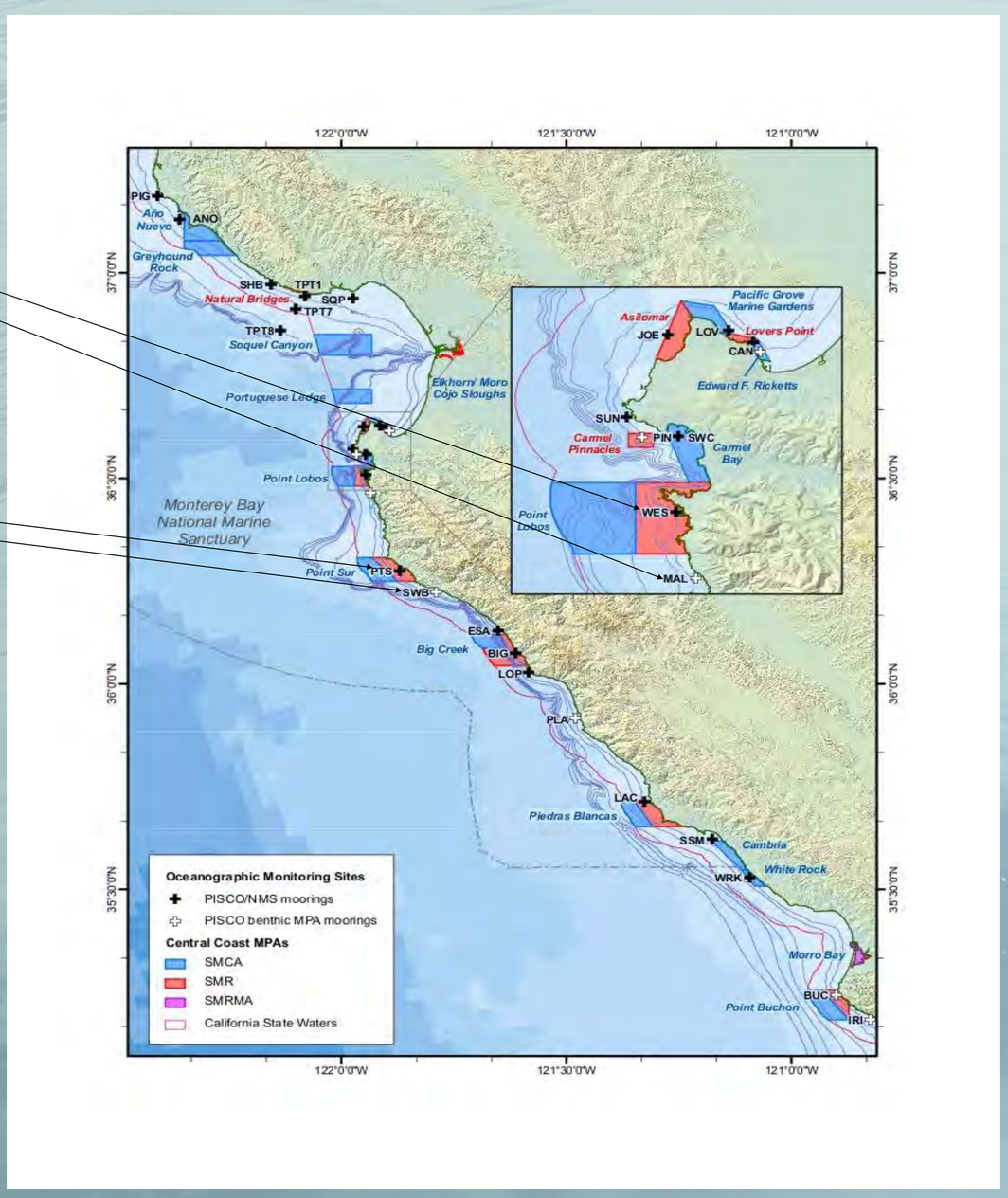


Figure 1. Oceanographic Moorings along the Central Coast study region.

Special Thanks: R/V Fulmar and her crew, Dan Malone, Devona Yates, Scott Gabara, Christian Orsini, Randolph Skrovan, Dave Benet, Armand Barilotti, Paul Leary, Steve Lonhart, Lars Davenport, Christine Donahue, Terril Efird, Moorea Anderson, Chad King, Scott Kathey, Jean DeMarignac, Margaret McManus,
Supporting Agencies and Partners: Monterey Bay National Marine Sanctuary, Office of National Marine Sanctuaries, CenCOOS, Sea Grant, The David and Lucile Packard Foundation, Gordon and Betty Moore Foundation, California Ocean Protection Council, UC Santa Cruz,

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Photo: Scott Gabara